ER-1: Match Airspace Design to Demands

Design and manage en route airspace to accommodate complexity and congestion.

Background

The structure of en route airspace has stayed virtually the same for the last several decades. However, demands on this airspace have significantly increased. The number of aircraft has increased, as has the diversity in the performance and type of aircraft operating (e.g., regional jets). Programs such as the North American Route Program (NRP) and Free Flight have increased the number of aircraft flying off structured air routes. Holding areas for arrivals frequently create undesirable interactions with en route flows. In some cases, the interaction causes ground delays in order to manage increased volume in an already busy sector, and in other cases, it is a matter of contention for the same physical airspace, which results in vectoring. This holding (including no-notice holding) and the static structure of today's sectors have exacerbated congestion and complexity in the en route environment.

In the areas where congestion routinely occurs, the only means presently available to supplement current resources is to add additional sectors (through resectorization and restratification, e.g., split existing sectors). This requires floor space, sector equipment and spectrum to be available for this temporary resource. New methods for managing and applying needed resources to en route sectors are needed.

Ops Change Description

There are four approaches proposed to deliver the desired operational change in the design and management of en route airspace:

- ER-1.1: Move holding areas that affect en route flows.
- ER-1.2: Redesign en route airspace, including adding/adjusting sector size and shape or developing rerouting options to alleviate congestion and complexity.
- ER-1.3: Implement the High Altitude Airspace Redesign.
- ER-1.4: Apply limited dynamic sectorization techniques to better manage available resources.

With regard to holding areas, the desired operational change is to make holding for the major eastern metropolitan areas of New York, Philadelphia, and Washington DC less disruptive to surrounding transition and en route operations. In the near-term, as part of the National Airspace Redesign System Choke Points, procedural and traffic management approaches are being applied to deal with impacts in the Great Lakes Corridor. As part of the NY/NJ/PHL Redesign and the Potomac Consolidated TRACON Redesign, airspace changes to accommodate holding within terminal airspace are being explored. Terminal holding should facilitate more efficient management of holding patterns, by minimizing coordination between en route facilities (sometimes multiple centers) and the TRACON. (Please refer to the terminal airspace redesign efforts discussed in AD-3.3.)

Changes to the overall airspace structure, including addition of new sectors in the Northeast, Mid-Atlantic, and Great Lakes Corridor, have been proposed as a means for managing workload distribution. Initially, redesign efforts will focus on optimization of existing resources by splitting and restratifying sectors, potentially creating additional sectors. Later efforts will include larger scale redesign actions, including sectorization concepts that may increase sector size and result in consolidation in the number of sectors. Activities included in the National Airspace Redesign System Choke Points Program, Regional Airspace Projects, and High Altitude Concepts represent the airspace changes expected between 2001 and 2006.

With the ever-increasing dynamic nature of en route flows, airspace boundary flexibility is needed to support dynamic airspace management. Concepts surrounding dynamic sectorization include a range of options from limited to full elasticity of what are currently static sector boundaries. Research is on going to determine how much flexibility is warranted and feasible. In the near- and mid-term, this flexibility can be achieved through Limited Dynamic Sectorization (LDR). LDR can be accommodated within most of the current constraints of the NAS infrastructure (automation, communications, etc.). Center by center development of limited dynamic sector configurations (consisting of multiple plans for a single facility, i.e., an LDR "casebook"), allows the team to focus the resources where the congestion exists by selecting one of several plans. This dynamic allocation reduces the need for dedicated resources, and provides more options to manage congestion.

Benefit, Performance and Metrics

Decoupling Holding Areas:

- Reduce the number of ground delay programs for congestion due to holding for a TRACON or Airport Demand imbalance
- Reduce the number of ground stop programs for congestion due to holding for a TRACON or Airport Demand imbalance
- Increase scheduled throughput as compared to actual for flows to cities whose arrivals have been identified as receiving unpredictable en route delays due to holding for a specific airport or TRACON.
- Decrease the estimated time en route for flights to cities with arrivals that have been identified as receiving predictable en route delays due to holding for a specific airport or TRACON.

Sectorization, restratification, and reroutes:

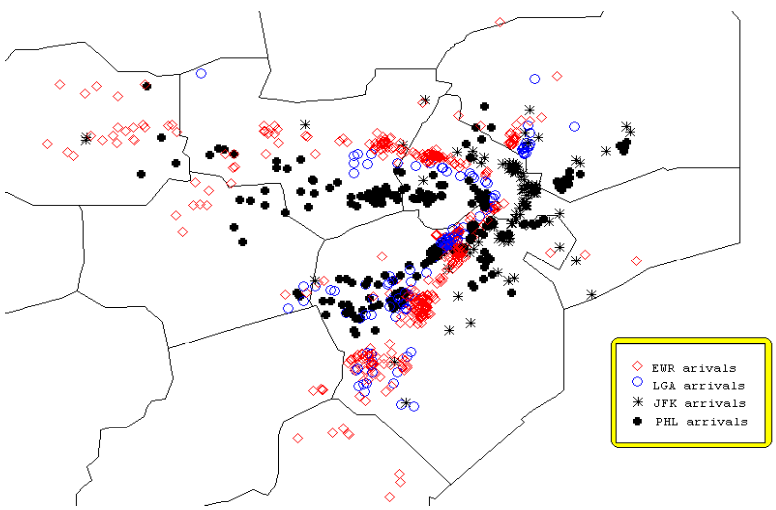
- Reduce the number of ground delay programs for volume congestion
- Reduce the number of ground stop programs due to volume congestion
- Increase scheduled throughput as compared to actual for flows to cities whose arrivals have been identified as receiving unpredictable en route delays due to volume congestion a sector or set of sectors.

- Decrease the estimated time en route for flights to cities with arrivals that have been identified as receiving predictable en route delays due to volume congestion a sector or set of sectors.
- Reduce restrictions used to manage sector complexity and congestion

Limited Dynamic Sectorization:

- By dynamically balancing traffic flows, better manage complexity resulting in increases in sector throughput rates.
- Reduce restrictions used to manage sector complexity and congestion by using LDR.

ER-1.1 Move Holding for Washington, NY Airports and PHL



Airborne Holding Locations for EWR, LGA, JFK, PHL (VFR days, April 1999)

Scope and Applicability

- En route holding within the Great Lakes Corridor for New York and Philadelphia metropolitan airports has been identified as one of the National Airspace Redesign System Choke Points. Smoothing, Choke Point Action Item #16, is in process of operational evaluation. The concept of smoothing is three-fold: a change to NRP egress points, rerouting of aircraft through Canadian airspace, and application of traffic management procedures to alleviate complexity in en route airspace.
- In the mid-term, the Potomac Redesign project is examining airspace design alternatives that bring holding patterns for DC metropolitan airports into the Potomac Consolidated TRACON. The planned implementation for the PCT Redesign is 2003.
- In the long-term, the NY/NJ/PHL Redesign project is examining airspace design alternatives that bring holding patterns for the major New York airports under the control

of NY TRACON (N90). The planned implementation for the NY/NJ/PHL Redesign is 2005/2006. Current alternatives are considering the use of terminal holding patterns.

Key Decisions

- None identified.

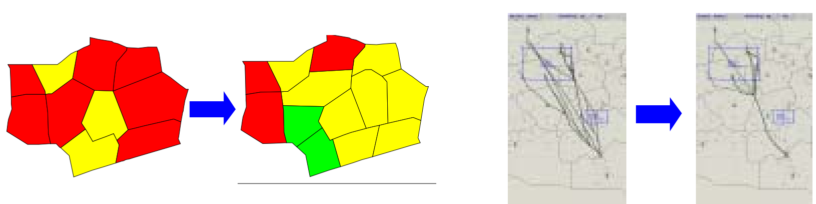
Key Risks

- None identified

Status of Key Milestones

- NRP Modifications and Smoothing initiatives, which are part of the Choke Points Action Items, have been completed. Smoothing techniques are being applied in Chicago Center. The NRP Modification evaluation started in January 2001. NRP ingress and egress points were adjusted to Iowa City, and use of these traffic management initiatives are discussed daily as part of the Strategic Planning Teleconference. To date, more structured flows have increased sector throughput & helped decrease complexity.
- Rerouting aircraft through Canadian airspace is used routinely as a viable offload alternative during peak traffic periods

ER-1.2 En Route Airspace Optimization and Redesign



Current Sectors — Proposed Sectors — Current Routes — Proposed Reroutes

Scope and Applicability

The optimization and redesign of en route airspace consists of two main concepts. The first involves changing the number or size or shape of the sectors in the en route airspace. The second involves adjusting existing routes or developing new routes through these sectors. These techniques can be applied separately or together to alleviate congestion and complexity in the en route airspace.

- In the near-term, 19 new sectors have been identified as part of the National Airspace Redesign System Choke Points Action Plan. These sectors are located in the en route and terminal facilities in New England, Eastern, and Great Lakes Regions and will be operational by mid 2002.

- In the mid- and long-term, en route restratification and resectorization is planned for all en route centers in the U.S. Redesign plans have scheduled evolutionary implementation of these airspace projects between 2002 and 2006, including Kansas City ARTCC in 2003, Oakland ARTCC and Los Angeles ARTCC in 2004, and Great Lakes Corridor centers in 2006.
- Rerouting is being used primarily east of the Mississippi to address complexity and congestion. In the near- and mid-term, reroutes are being used to address several of the System Choke Points in the Great Lakes Corridor and traffic flowing north-south between the Great Lakes and Northeast to Atlanta and Florida.

Key Decisions

- There are currently over 700 sectors in the NAS, with over 100 additional sectors under consideration. In the near- and mid-term adding or splitting sectors may be the only way to alleviate key areas of congestion in the en route airspace. Air Traffic needs to determine the right level of sectorization, if/when it will need to pursue a strategy to reduce the number of sectors (while addressing the concerns of increased complexity and congestion) and evaluate how evolving technologies can support the reduction of the number of sectors.

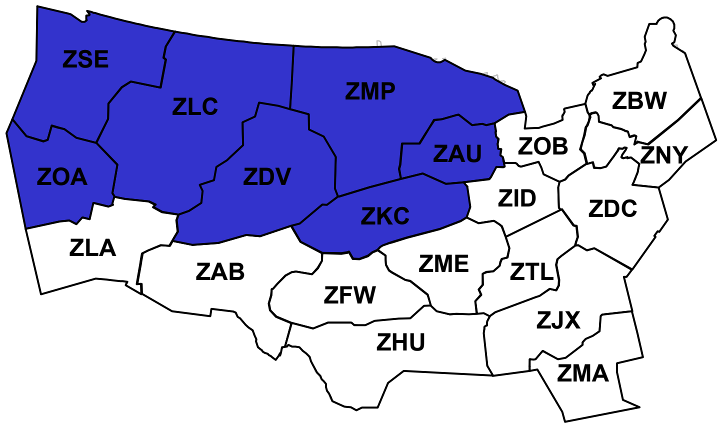
Key Risks

- Several infrastructure adjustments will be needed to support new sectors, including availability of building space, ATC automation, controller position equipment, and additional frequencies. Lack of availability of these systems may negatively impact the ability to transition to new sectorization or to implement additional sectors. Limitations of the current systems, specifically the HOST computer, will limit potential efficiency of some of the proposed airspace changes.
- VTABS (VSCS Training and Backup System) capacity is limited to 50 positions in each en route center. Upgrades and expansion are not available. There are no program requirements or funding to provide needed additional capacity. Currently no additional sectors can be added to ZAU (maxed out at 50 positions); ZOB is at 48 positions.

Status of Key Milestones

- Eleven Choke Points sectors implemented to date. To date, the implementation of these sectors, augmented with other choke points action items (e.g., NRP modifications) have resulted in the following benefits:
  - For Great Lakes area airports (CLE, ORD, DTW, MDW, PIT): departure (22%), arrival (27%), and block (22%) delays have been reduced from 2000 to 2001. Weather delays during this same time period did not change significantly.
  - Departure access for major airports in the Great Lakes Corridor (CVG, DTW, ORD) has improved. For departures from these key airports, departure (28%), arrival (31%) and block (27%) delay have decreased (weather delays during this same time period did not change significantly).

ER-1.3 Implement High Altitude Redesign



High Altitude Redesign – Phase 1

Scope and Applicability

The objective of the High Altitude Concept is to provide aviation users the greatest opportunity to operate on their preferred profiles and at efficient altitudes. When the High Altitude Airspace Concept is fully implemented, the FAA will utilize technology and airspace concepts/designs to provide the most efficient flight to aircraft operating in high altitude. The airspace will be designed to allow this flexibility with minimal constraints due to boundary conditions and maximum latitude for required maneuvers.

The High Altitude Concept uses an evolutionary implementation approach timed to match airspace design, adaptation, automation, and infrastructure development timelines. This approach capitalizes on available technologies to deliver early benefits while concurrently developing the longer-term requirements. These items include sector characteristics, alignment of the airspace with existing and/or new organizational structures, and cognitive and display requirements for modification to decision support tools.

In the mid-term, Phase 1 of the High Altitude Concept will implement as many operational changes for flexibility as possible within the constraints of the current automation and infrastructure. The airspace will be designed to provide the maximum utilization of point-to-point navigation given these constraints. To achieve desired flexibility the airspace will be designed for RVSM operations. RNAV routing for the high altitude will be designed to most efficiently accommodate the transition to high-density terminals and to support the avoidance of active special use airspace.

In the long-term, later phases of the High Altitude Concept may incorporate procedural separation on closely space routes, full domestic RVSM (see ER4), and required time of arrival for transition into en route and terminal airspace.

Phase 1 encompasses an initial implementation with a seven-centers planned for early 2003. This area provides all the characteristics required to evaluate initial changes in procedures and airspace designs. This airspace includes major city pair flows that include high altitude cruise as well as transitioning aircraft from ocean tracks. During the initial implementation, a decision will be made on the most effective next step. That is, whether to proceed by first extending the procedures and designs to lower altitudes within the seven centers or extending procedures and designs across all 20 centers.

In preparation for later phases, validation and requirements activities will be conducted concurrently with Phase 1. This activity includes the analysis and engineering studies needed to develop requirements for automation, infrastructure, procedures, sector design, and organizational alternatives (including staffing requirements, team dynamics, sector team composition) to achieve the full objectives of the High Altitude Concept. The best characteristics for high altitude sectors and related organizational structures will be developed and evaluated against current and forecast traffic characteristics, opportunities afforded by improved airborne and ground based technologies, and potential improvements in decision support tools.

Key Decisions

Phase 1:

- The FAA and user community need to determine if the airspace designated for the High Altitude Airspace operations will be exclusionary and mandate equipage levels. If exclusionary airspace is identified, transition paths will need to be developed to accommodate non-equipped users.
- Users will require access to information on SUA scheduling and usage to allow them to define and file optimal trajectories. This includes information on ATCAA usage. SAMS will be the primary mechanism to provide the data. Procedures and mechanisms for public access to the data are being developed.

Later Phases:

- The FAA needs to establish the expansion plans for the High Altitude Concept (when to expand to lower altitudes and beyond the initial seven-centers), including the final altitude floor for the High Altitude Concept.
- If the decision is made for mandated equipage or exclusionary airspace use, rulemaking will be needed.
- Adoption of a uniform grid naming convention and its inclusion into the en route adaptation will be needed. This grid naming convention provides a rich uniform net of fixes to support user development of RNAV profile, clear minimal change clearances for required controller intervention and a robust procedural backup to automation failures.
- The FAA needs to determine sector characteristics (size, team composition, communication and automation requirements, etc.) to provide the most efficient individual flights and flow in high altitude cruise.

- The FAA should decide on the appropriate facility structure (number and size of en route facilities) to effectively support the High Altitude Concept, including management of the staffing, training, automation, displays and infrastructure to support the sectorization.

Key Risks

- Charting and real-time management of all forms of airspace usage (i.e., ATCAAs) is needed to support development of user-preferred routing that require minimal controller intervention.
- Funding for operational positions (overtime in the short-term) and ability to hire controllers for new positions will impact ability to implement the concept.
- Several infrastructure adjustments may be needed to support new sectors. Availability of these systems may impact the ability to transition to implement concept:
  - ATC Host/ERAM automation.
  - Frequencies for transitioning and new sectors; enlarging sectors would affect the ground communications infrastructure. Existing radio sites may not provide adequate coverage for the larger sectors, so two or more sites containing radios operating on the same frequency may be required.
  - There may be a need to modify surveillance linkages, and existing ground automation systems may not be capable of accepting additional inputs. Other infrastructure considerations include system adaptation and the possible use of new coordinate systems.
- Controller automation aids (e.g., URET, CRCT, TMA) may be needed to support the non-restrictive routing and transitioning to and from High Altitude airspace.

ER-1.4 Multiple Sector Configurations

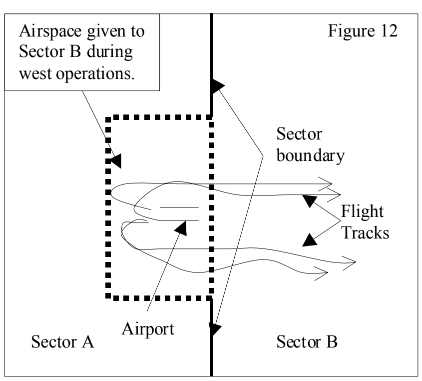


Figure 12

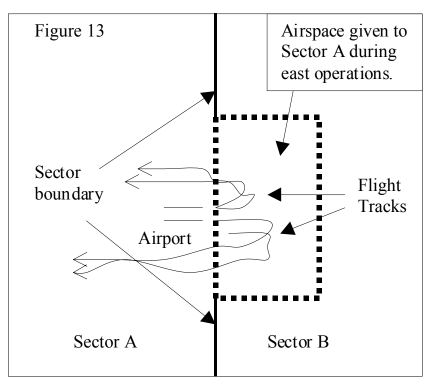


Figure 13

Scope and Applicability

Airspace boundary flexibility in the near- and mid-term can be achieved by leveraging the limited flexibility that already exists in the system. Many facilities have found ways to support a limited form of dynamic sectorization within the constraints of current automation. These strategies that are feasible without modifying the current automation system are referred to as Limited Dynamic Resectorization (LDR).

Several en route centers apply LDR to address equipment outage (ZMA), weather (ZJX), special use airspace (ZJX), airport configuration change (ZTL), traffic volume (ZMP), and oceanic track change (ZOA). The LDR Casebook has been developed using these centers as examples of LDR application. The casebook has been distributed to all 20 ARTCCs with expectations of proliferating LDR concepts within the near- and mid-term time frames.

Key Decisions

- None identified.

Key Risks

- None identified.

Status of Key Milestones

- December 2000 completed Limited Dynamic Sectorization Casebook, distributed to all regions and en route facilities. Workshop held to promote use of LDR and share knowledge, experience and expertise among facilities.